September 29th, 2021

2020 National Survey of Children's Health

Nonresponse Bias Analysis

Nonresponse Bias Analysis for the 2020 National Survey of Children's Health[1]

Executive Summary

In accordance with Office of Management and Budget standards, a nonresponse bias analysis is conducted annually for the National Survey of Children's Health (NSCH) in order to identify potential sources of bias in the estimates due to the nonresponse, and determine the degree to which survey weight adjustments alleviate any bias that is found. The goals for the analysis of each year of the NSCH are: (1) to describe how the NSCH nonrespondents are different from the respondents; (2) to describe how well the weighting adjustments used to correct for nonresponse performed; and (3) to present and discuss the effect of nonresponse, and the weighting corrections for nonresponse, on selected key survey estimates.

Frame information (i.e., NSCH Screener response data, NSCH frame data, and block group-level or tract-level frame data from the American Community Survey) from respondents is compared to all of the cases eligible for the Screener and for the Topical NSCH questionnaires. The overall nonresponse bias is then estimated for the frame variables, and logistic regression models are used to translate the estimated overall biases in the variables into estimates of bias in key survey estimates. Evidence of bias are also further examined by comparing NSCH estimates to similar estimates from other surveys.

Notable findings for the 2020 NSCH:

- Taking all analyses into account, there is no strong or consistent evidence of nonresponse bias after survey weights were applied.

- Nonresponse was generally greater in areas with larger non-White populations and areas having lower household incomes, less homeownership, and fewer college graduates. As such, there is a possibility that some bias related to income remains in the 2020 NSCH estimates. However, the analysis of the estimates did not provide consistent support for an income bias; therefore, the expectation is that if an income bias exists, it is small.

- The small biases found in frame information translate into even smaller biases in key survey estimates. Nineteen of 21 key survey estimates had a remaining bias of four percent or less after nonresponse weighting adjustments were applied.

- Some differences exist between 2020 NSCH estimates and similar estimates from other surveys; however there was not evidence of a large bias in the 2020 NSCH estimates being compared. These differences may reflect differences in the timing of data collection, item wording, and/or the mode of data collection.

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[1] The U.S. Census Bureau reviewed this data product for unauthorized disclosure of confidential information and approved the disclosure avoidance practices applied to this release. CBDRB-FY21-POP001-0210.

I.   Introduction

<u>Motivation</u>

Standard 1.3 of the Office of Management and Budget Standards and Guidelines for Statistical Surveys (2006) states that "Agencies must design the survey to achieve the highest practical rates of response, commensurate with the importance of survey uses, respondent burden, and data collection costs, to ensure that survey results are representative of the target population so they can be used with confidence to inform decisions." Implicit in this standard is the assumption that the frame variables (e.g., stratum) used at the design state are sufficiently predictive of the collection variables (e.g., number of eligible children in the household) for this to be feasible. Under this assumption, standard nonresponse bias analysis techniques are applied to study potential areas of nonresponse bias in the survey estimates.

Three goals of this analysis of nonresponse bias in the 2020 National Survey of Children's Health (NSCH) are:
1.   To describe how the 2020 NSCH Screener and Topical nonrespondents are different from their respective Screener and Topical respondents.
2.   To describe how well the 2020 NSCH Screener and Topical weighting adjustments that were used to correct for nonresponse performed.
3.   To present and discuss the effect of nonresponse, and the weighting corrections for nonresponse, on selected key survey estimates (KSEs).

Using frame information (i.e., NSCH Screener response data, NSCH frame data, and block group-level or tract-level frame data from the American Community Survey (ACS))[2], information from respondents is compared to all of the cases eligible for the Screener and for the Topical. Since most of the frame information is available for both respondents and nonrespondents of the Screener and Topical stages, the stage-specific nonresponse bias in these frame variables can be measured directly. The overall nonresponse bias is then estimated for the frame variables and logistic regression models are used to translate the estimated overall biases in the variables into estimates of bias in the KSEs.

A comparison of response rates across the frame variables, comparing above and below the median, could indicate the presence of nonresponse bias in the 2020 NSCH. If the response rate is lower (or higher) for a particular subgroup[3] relative to that of other subgroups, then that would indicate that the subgroup is under-represented (or over-represented) in the final sample, and, to the extent that a KSE is different for that particular subgroup compared with

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[2] A census block group is a geographical unit used by the U.S. Census Bureau and it is the smallest geographical unit for which the Census Bureau publishes sample data. A single block group consists of clusters of blocks within the same census tract and each tract contains at least one block group. A block group usually covers a contiguous area, and never crosses state, county, or census tract boundaries, but may cross the boundaries of any other geographic entity; it is generally defined to contain between 600 and 3,000 people.

[3] Percent Owner is an example of a frame 'variable' or 'characteristic'; an example of a 'subgroup' is greater than the median for the frame variable Percent Owner.

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other subgroups, there would be bias in the overall survey estimate. If the response rate is the same across subgroups, or if a KSE does not differ by these subgroups, the KSE could still be biased, but unequal response rates across these subgroups will have been ruled out as a source of bias.

<u>Weighting Framework and the Types of Nonrespondents at each Stage</u>

As presented in the Source and Accuracy Statement for the 2020 NSCH (Tersine, 2021), Figure 1 provides a framework for the weighting steps that were implemented from sample frame to final outcome. The process used the data from each phase of the data collection, from both the paper and Centurion (web) instruments, to produce final weights for the screened-in households[4], Screener children, and interviewed[5] children via the Topical.

Figure 1. 2020 National Survey of Children's Health - Sample Frame to Final Outcome[6]
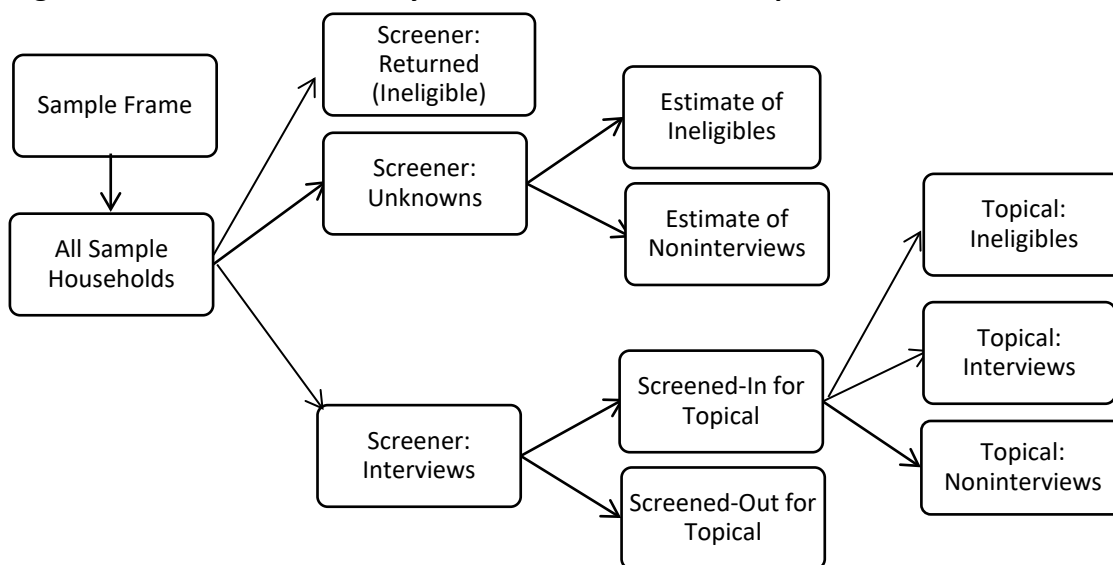
The weighting process for the interviewed children began with the base weight (BW) for each sample household, followed by a Screener nonresponse adjustment (SNA). Then, the eligible children from the Screener interview cases were raked to population controls (Child-Level Screener Factor = CLSF), a within-household subsampling factor (WHSF) was applied to the Screener interview cases, and a Topical nonresponse adjustment (TNA) was applied to the Topical interview cases. As a factor for the final weight for interviewed children, a raking adjustment (RAK) to various demographic controls, and trimming of extreme weights[7] as

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[4] Since the household-level weight is not addressed in this report, discussion of its factors is omitted.

[5] Children or households are not actually interviewed in the NSCH; the term 'interviewed' is used to represent information gathered from the paper and web questionnaires.

[6] Figure 1 shows a box representing Topical Ineligibles. An example would be a household that reports a child on the Screener, but then the child who was selected as the sample child is no longer present when the Topical arrives at the address.

[7] A weight was considered extreme if it exceeded the median weight plus six times the interquartile range of the weights in a state.

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necessary, was lastly performed. The weighting process for all Screener children was a subset of these six factors.

Final Weight for Interviewed Children = BW × SNA × CLSF × WHSF × TNA × RAK
Final Weight for Screener Children = BW × SNA × CLSF

II. Details on Base Weights and the Adjustments for Screener and Topical Nonresponse

<u>Base Weights</u>

The weighting process began with the base weight for each sample household. The base weight for each sample housing unit was the inverse of its probability of selection for the Screener. Base weights were calculated separately for each of the two sampling strata[8] for each state, including the District of Columbia. If there was no nonresponse and the survey frame was complete, using this weight would give unbiased estimates for the survey population.

<u>Adjustment for Screener Nonresponse</u>

Following the base weight, an adjustment for Screener nonresponse was implemented to increase the weights of the households that responded to the Screener in order to account for all of the households that did not respond to the Screener. Households were put into one of 16 cells defined by stratum, a block-group poverty measure variable indicating the proportion of households with income less than 150 percent of the poverty rate, an indicator of the likelihood of households to respond by paper, and whether they reside inside or outside of a Metropolitan Statistical Area (MSA). The Screener nonresponse adjustment factor was calculated within each cell using the following formula:

$$\left(\frac{\text{weighted sum of Screener interviews } + \text{ weighted number of Screener noninterviews}}{\text{weighted sum of Screener interviews}} \right)$$

where the number of Screener noninterviews =

$$\left(\frac{\text{weighted sum of Screener interviews}}{\text{weighted sum of Screener interviews + weighted sum of Screener ineligible households}} \right) \times$$

$$\text{(weighted sum of households with unknown Screener eligibility)}$$

In other words, the count of Screener noninterviews was an estimate of the expected number of eligible households from those cases for which nothing was received back. The term "eligible" here refers to the address belonging to an occupied, residential household. The expected number of eligible cases was estimated by taking the eligibility rate among the known

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[8] Households flagged as having at least one child under the age of 18 based on administrative records were assigned to Stratum 1; all other households were assigned to either Stratum 2a or 2b, with no sampling occurring in Stratum 2b. See the 2020 NSCH Methodology Report (U.S. Census Bureau, 2021) for a more detailed description of the different strata.

cases and applying it to the unknown cases. The Screener nonresponse adjustment was the last step of the weight processing that included the households for which there was no Screener interview as well as the Screener-interviewed households that indicated no eligible children.

Adjustment for Topical Nonresponse

Similar to the Screener nonresponse adjustment, the weights of the households responding to the Topical needed to be increased to account for all of the households not responding to the Topical. If the respondent reached Section H of the Topical questionnaire and answered at least 50 percent of the key items, then it was considered a Topical interview. (Key items are 50 items on the Topical instrument that are on path for all respondents.) A returned Topical that did not meet these conditions was considered a Topical noninterview.

All Topical eligible households were put into one of 16 cells depending on imputed poverty/non-poverty status (based on 150 percent of the poverty rate), web group (high paper vs. low paper/high web), tenure (owner occupied or not), and presence of a child with special health care needs (CSHCN). The Topical nonresponse adjustment was calculated within each of the 16 cells using the following formula:

$$\frac{\text{weighted sum of Topical interviews } + \text{ weighted sum of Topical noninterviews}}{\text{weighted sum of Topical interviews}}$$

III.   File Creation for the Nonresponse Bias Analysis

Several of the approaches used to assess nonresponse bias rely heavily on the availability of information for both respondents and nonrespondents. There is normally very limited information on nonrespondents; however, since this survey was an address based survey, block group and tract-level data from the 2019 ACS 5-year Summary File could be attached to the entire NSCH sample.[9] Each household is located in a single tract and block group. The proportions (e.g., Percent White Alone) and median values (e.g., median home value) for each of the frame variables used are known for each block group or tract based on ACS data[10]. The block group or tract measure was assigned to each household in the associated block group or tract. The overall median of each frame variable was then calculated and each NSCH record was put into one of two subgroups based on whether its block-group or tract value was above or below the overall median. Table 1 shows the information that is known for both respondents and nonrespondents, either at a geographic level or from the Screener.

Median comparisons at the block group or tract level were not necessary for data that were available for each individual sample address. This includes data from NSCH Screener interviews

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[9] Some sampled households have not yet been geocoded (i.e. have not yet been assigned block group and tract) and thus had to be dropped from analyses that involved the block group and tract-level data.
[10] If there were no data for a specific ACS frame variable for a block group, or if there were too many missing values at the block group level, then the ACS data for that variable were summarized to the tract level. This happened for median income, median home value, and median gross rent.

(number of eligible children in the household and presence of CSHCN) and data that were available for each individual address on the NSCH sample frame (stratum and MSA status).

<div align="center">Table 1: Information Available for Both Respondents and Nonrespondents</div>

Variable	Description
# of Eligible Children in the HH*	Number of children age 0-17 years in the household as indicated on the Screener
Presence of CSHCN†	Indicator of whether or not there are any CSHCN in the household as indicated on the Screener
Presence of Child Flag	Stratum Identifier: Households flagged as having at least one child under the age of 18 were assigned to Stratum 1, all other households were assigned to Stratum 2
MSA‡ Status	Indicator of whether the household is inside or outside of an MSA
Median Household Income	Median household income in the tract
Median Home Value	Median home value in the tract
Median Gross Rent	Median gross rent in the tract
Tenure: Percent Owner	Percent of the population in the block group that owns their home
Percent College Grad	Percent of the population in the block group that is a college graduate
Percent Hispanic	Percent of the population in the block group that is Hispanic
Percent Black Alone	Percent of the population in the block group that is Black alone
Percent White Alone	Percent of the population in the block group that is White alone
Percent Asian Alone	Percent of the population in the block group that is Asian alone
Percent Other Race	Percent of the population in the block group that is not Black alone, White alone, or Asian alone

* HH – Household
† CSHCN – Children with Special Health Care Needs
‡ MSA – Metropolitan Statistical Area

IV.   Key Survey Estimates

As listed under the Motivation in Section I, one goal of this analysis is to examine the relationship between the nonresponse bias in the frame variables and the bias in selected KSEs. The following 21 KSEs, which have been assessed in each annual nonresponse bias study since the launch of the redesigned NSCH in 2016, were chosen as the focus of this analysis:

1.   Percent of CSHCN
2.   Percent of children with any kind of emotional, developmental, or behavioral problem needing treatment or counseling
3.   Percent of children with current asthma
4.   Percent of children with current Autism Spectrum Disorder (ASD)
5.   Percent of children with current anxiety
6.   Percent of children ever diagnosed with Attention Deficit Disorder (ADD) or Attention Deficit Hyperactivity Disorder (ADHD)
7.   Percent of children (6-17 years) who are bullied[11]
8.   Percent of children (1-17 years) with "excellent" condition of teeth

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[11] The underlying item for KSE 7 changed in 2018 and we saw a dramatic increase in the prevalence estimate.

9. Percent of children in excellent or very good health
10. Percent of children (0-5 years) ever breastfed
11. Percent of children with a personal doctor/nurse
12. Percent of children who were ever covered by any kind of health insurance or health coverage plan during the past 12 months
13. Percent of CSHCN who were ever covered by any kind of health insurance or health coverage plan during the past 12 months
14. Percent of CSHCN whose families paid $1,000 or more out-of-pocket for medical and health care in the past 12 months
15. Percent of CSHCN whose health status caused family members to cut back or stop working in the past 12 months
16. Percent of CSHCN (12-17 years) who had at least one preventive medical visit with a doctor, nurse, or health care professional in the past 12 months[12]
17. Percent of children (6-17 years) who exercised, played a sport, or participated in physical activity at least one day during the past week, for at least 60 minutes
18. Percent of children (1-5 years) with > 1 hour/day of screen time[13]
19. Percent of children with family meals every day of the week
20. Percent of children with sidewalks or walking paths in their neighborhood
21. Percent of children where someone smokes in the household

V.   Assessing Nonresponse Bias in the 2020 NSCH

Weighted Response Rate Comparisons

As stated in Section I, a comparison of response rates across subgroups could reveal the presence of nonresponse bias in a survey. If the response rate is lower (or higher) for a particular subgroup relative to that of other subgroups, then that would indicate that the subgroup is under-represented (or over-represented) in the final sample. To the extent that a KSE is different for that particular subgroup when compared with other subgroups, there could be bias in the overall survey estimate.

Table 2 presents the national weighted response rates for Screener respondents using the base weights and the weighted response rates for Topical respondents using the adjusted weights of all households receiving a Topical, across subgroups of the frame variables. For each of the ACS block group or tract frame variables, households were classified into two subgroups: those with values above and those with values below or equal to the median value of the variable for all Screener or Topical respondents and nonrespondents.

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[12] The feeder question for KSE 16 (i.e., any medical care in the past year) changed in 2018 and we saw a dramatic drop in the prevalence estimate.

[13] In 2016 and 2017, KSE 18 only referred to TV time. In 2018 and thereafter, the TV item was combined with the item asking about time spent on a computer, video games, etc., resulting in a single "screen time" item.

Frame Variable/Subgroup	Screener Respondents		Topical Respondents	
	Frequency	Weighted Response Rate[a] (%)	Frequency	Weighted Response Rate[b] (%)
--- National Survey of Children's Health Screener Response Data ---				
# of Eligible Children in Household				
1 ……………………………………			17,500	82.99
2 ……………………………………			17,000	81.69
3 ……………………………………			6,000	79.01
4+ ……………………………………			2,500	74.83
Presence of Children with Special Health Care Needs				
Yes …………………………………			13,000	82.42
No …………………………………			30,000	79.66
--- Frame Data: National Survey of Children's Health ---				
Presence of Child Flag				
Stratum 1 …………………………	57,000	40.68	39,500	81.82
Stratum 2a …………………………	35,500	45.31	3,000	74.21
Metropolitan Statistical Area (MSA) Status				
In MSA ………………………………	72,500	43.20	34,500	80.67
Not in MSA ……………………………	20,500	46.14	8,000	79.34
--- Frame Data: American Community Survey Block Group or Tract Data ---				
Median Household Income				
≤ median …………………………	40,000	38.23	16,000	77.32
> median …………………………	52,000	48.94	26,500	82.99
Median Home Value				
≤ median …………………………	40,500	39.98	17,000	78.36
> median …………………………	51,000	47.55	25,000	82.48
Median Gross Rent				
≤ median …………………………	43,000	41.74	18,000	79.36
> median …………………………	48,000	44.99	23,500	81.13
Tenure: Percent Owner				
≤ median …………………………	41,000	38.48	17,000	78.04
> median …………………………	51,000	49.40	25,500	82.67
Percent College Graduate				
≤ median …………………………	39,500	38.25	16,500	76.75
> median …………………………	52,500	49.06	26,000	83.88
Percent Hispanic				
≤ median …………………………	48,500	47.42	23,000	82.43
> median …………………………	43,500	40.80	19,500	79.18
Percent Black Alone				
≤ median …………………………	50,500	48.59	23,500	81.93
> median …………………………	42,000	40.07	19,000	79.43
Percent White Alone				
≤ median …………………………	42,000	39.81	18,500	79.02
> median …………………………	50,000	48.68	24,000	82.49
Percent Asian Alone				
≤ median …………………………	44,000	42.09	19,500	78.34
> median …………………………	48,000	44.94	23,500	82.14
Percent Other Race				
≤ median …………………………	48,000	46.22	23,000	82.13
> median …………………………	44,000	41.19	19,500	79.04

Source: U.S. Census Bureau, 2020 National Survey of Children's Health internal data.

Note: See appendix for standard errors.

[a] Using BW of all eligible sample cases.

[b] Using weights of all households receiving a Topical: BW × SNA × CLSF × WHSF.

The 2020 response rates of all Screener subgroup pairs were significantly different at the 95 percent confidence level. For the Topical, the response rates for all of the subgroup pairs were also significantly different with the exception of the following pairs:

- Households with one eligible child vs. households with two eligible children
- MSA status

Table 2 shows that Screener response rates were five percentage points different for Stratum 1 versus Stratum 2a and two percentage points different for MSA status. It is likely that Screener response was greater in Stratum 2a because there were fewer households with children, thereby easing the task of responding. Looking at both Screener and Topical response, it was generally more difficult to obtain interviews from households in areas with larger non-White populations and areas having lower household incomes, less homeownership, and fewer college graduates (all around 9 to 11 percentage points different from their median counterparts).

There are two limitations to this approach. First, to form subgroups, each continuous sampling frame variable had to be categorized into groups, resulting in less precise measures of these variables. Second, the adjusted response rates presented in Table 2 reflect only the weighting adjustments for nonresponse at the Screener stage and not the adjustment for nonresponse at the Topical stage or the final raking of the Topical weights to population control totals; the extent to which these additional weighting adjustments reduced the under- or over-representativeness of a particular subgroup in the final weighted sample was not captured by this analysis.

<u>Comparing Respondents and Nonrespondents across Various Frame Variables – The Effect of the Screener and Topical Nonresponse Adjustments</u>

For each stage of the survey (i.e., Screener and Topical), Table 3 shows a comparison of frame information for the entire sample eligible for the stage and for respondents to that stage, first using the weight before the nonresponse adjustment and then using the weight with the nonresponse adjustment. The purpose of Table 3 is twofold: to show the bias that may exist in the frame variables and to show if the Screener and Topical nonresponse adjustments were successful in reducing that bias. Ideally, we would like to see the distributions for each characteristic in the 'Using NR Adjusted Weight' columns three and six closely match the appropriate Screener or Topical bolded columns one and four. For most frame variables, the adjustment did indeed move the distribution closer from columns two and five to that of the appropriate all sample cases column (columns one and four), with the Topical adjustment performing better than the Screener adjustment. These results indicate that the adjustments mitigated much of the nonresponse bias that is correlated with the frame variables used in the analysis.

Table 3: Comparing Respondents and Nonrespondents Using Frame Information

(column #):	All Sample Cases Using Base Weight (1)	Screener Respondents Using Base Weight (2)	Screener Respondents Using NR* Adjusted Weight[a] (3)	All Topical Eligible Cases Using Weight Prior NR Adjustment[b] (4)	Topical Respondents Using Weight Prior NR Adjustment (5)	Topical Respondents Using NR Adjusted Weight[c] (6)
--- NSCH† Screener Interview Data ---						
# of Eligible Children in Household						
1 …………………………………				**22.97**	23.67	23.75
2 …………………………………				**41.77**	42.38	42.22
3 …………………………………				**22.62**	22.20	22.15
4+ …………………………………				**12.64**	11.75	11.88
Presence of CSHCN‡						
Yes …………………………………				**31.17**	31.90	31.40
No …………………………………				**68.83**	68.10	68.60
--- Frame Data: NSCH ---						
Presence of Child Flag						
Stratum 1 ……………………………	**36.66**	34.20	39.46	**82.87**	84.21	83.65
Stratum 2a ……………………………	**63.34**	65.80	60.54	**17.13**	15.79	16.35
MSA§ Status						
In MSA ………………………………	**85.82**	85.00	86.78	**88.37**	88.54	88.46
Not in MSA …………………………	**14.18**	15.00	13.22	**11.63**	11.46	11.54
--- Frame Data: American Community Survey Block Group or Tract Data ---						
Median Household Income …………	**71,410**	77,070	76,420	**77,670**	79,130	78,090
Median Home Value …………………	**277,800**	296,600	295,800	**297,100**	302,900	302,000
Median Gross Rent …………………	**1,197**	1,235	1,235	**1,258**	1,269	1,264
Tenure: Percent Owner ………………	**63.87**	67.83	67.05	**67.72**	68.54	67.66
Percent College Graduate ……………	**40.46**	43.54	43.16	**41.88**	42.93	42.42
Percent Hispanic ……………………	**17.28**	14.49	15.20	**18.58**	17.78	18.37
Percent Black Alone …………………	**13.27**	10.60	11.21	**12.33**	11.80	11.97
Percent White Alone …………………	**72.46**	75.72	74.88	**72.63**	73.47	72.84
Percent Asian Alone …………………	**5.33**	5.68	5.70	**5.84**	5.95	6.08
Percent Other Race …………………	**8.94**	8.01	8.22	**9.20**	8.79	9.11

Source: U.S. Census Bureau, 2020 National Survey of Children's Health internal data.

Note: See appendix for standard errors.

[a] BW × SNA

[b] BW × SNA × CLSF × WHSF

[c] BW × SNA × CLSF × WHSF × TNA

* NR – Nonresponse

† NSCH – National Survey of Children's Health

‡ CSHCN – Children with Special Health Care Needs

§ MSA – Metropolitan Statistical Area

Using Table 3, the bias can be calculated using the following formula:

$$\frac{\text{information from respondents} - \text{information from all eligible cases}}{\text{information from all eligible cases}}$$

For example, using the base weights for the Percent Hispanic variable, the sample is biased downward 16.15 percent (calculated as (14.49 – 17.28) / 17.28 = -16.15 percent) for the Screener and biased downward 4.31 percent (calculated as (17.78 – 18.58) / 18.58 = -4.31 percent) for the Topical. Using the weights that have been adjusted for nonresponse, the sample is biased downward 12.04 percent and 1.13 percent for the Screener and Topical respondents, respectively. Thus, the nonresponse adjustments lowered, but did not completely eliminate, the bias in the Percent Hispanic estimate. Table 3 shows that this is generally the case for the other frame variables as well. Nonresponse introduced small biases, but the nonresponse adjustments substantially reduced much of those biases. For the Topical respondents, the groups with the largest bias remaining after the nonresponse adjustments are households with four or more eligible children, which remains biased downward 6.01 percent, Stratum 2a which remains biased downward 4.55 percent, and percent Asian alone which remains biased upward 4.11 percent.

Note that the presence of child flag (i.e., Stratum), a poverty measure variable, and residence inside or outside of an MSA were three of the four variables which defined the 16 weighting cells for the Screener nonresponse adjustment; a poverty/non-poverty status variable, owner occupancy status, and presence of CSHCN were three of the four variables used to define the 16 weighting cells for the Topical nonresponse adjustment. The results in Table 3 for their frame variable counterparts largely support their choice to reduce nonresponse bias. Consideration will be given to including additional and/or different variables to the Screener and Topical nonresponse adjustments in the 2021 NSCH.

<u>Observed and Expected Means of Frame Variables for Respondents</u>

Table 4 shows the observed means of the frame variables for Topical respondents and the means that would be expected under full response. The bias is calculated as the product of two ratios: the Screener estimate for all sample cases over that for Screener respondents and the Topical estimate for all eligible cases over that for Topical respondents. The bias measurement is then applied to the observed values to get the expected values in Table 4.

For example, using the weight before the Topical nonresponse adjustment, the observed median household income is $79,130. Taking the bias into account, the expected value is 79,130 × (71,410/77,070) × (77,670/79,130) = $71,970. Similarly, using the Topical nonresponse adjusted weight, the observed value is $78,090. Taking the bias into account, the expected value is 78,090 × (71,410/76,420) × (77,670/78,090) = $72,580.[14]

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[14] Reported values are rounded to four significant digits.

Table 4: Observed and Expected Means of Frame Variables for Topical Respondents

	Using Weight Prior to Nonresponse Adjustment		Using Nonresponse Adjusted Weight	
	Observed	Expected	Observed	Expected
In Metropolitan Statistical Area (MSA)	88.54	89.22	88.46	87.39
Not in MSA	11.46	10.99	11.54	12.47
Median Household Income	79,130	71,970	78,090	72,580
Median Home Value	302,900	278,200	302,000	278,900
Median Gross Rent	1,269	1,219	1,264	1,219
Tenure: Percent Owner	68.54	63.77	67.66	64.51
Percent College Graduate	42.93	38.92	42.42	39.26
Percent Hispanic	17.78	22.16	18.37	21.12
Percent Black Alone	11.8	15.44	11.97	14.60
Percent White Alone	73.47	69.50	72.84	70.28
Percent Asian Alone	5.95	5.48	6.08	5.46
Percent Other Race	8.79	10.27	9.11	10.01

Source: U.S. Census Bureau, 2020 National Survey of Children's Health internal data.

The biases in the frame information translate into biases in the KSEs only to the extent that the frame information is related to the KSEs. To examine these relationships for each of the 21 KSEs, a logistic regression model was estimated of the following form:

$$p_i = \frac{e^{X_i'\beta}}{1 + e^{X_i'\beta}}$$

where p_i is the probability that the *i*th respondent's child is positive for the key survey variable
(e.g., has special needs, has anxiety, neighborhood has sidewalks or walking paths);
X_i' is a vector containing the frame information for the *i*th child; and
β is a vector of unknown parameters to be estimated.

By evaluating the fitted model first at the observed means of the frame information and then at the expected means of the frame information from Table 4, an estimate of the bias in each KSE was generated that could be attributed to biases in frame variables due to nonresponse. These estimates of biases in the KSEs using this approach are shown in the next section's Table 5.

Estimates of Nonresponse Biases in the Key Survey Estimates

As Table 5 shows, small biases in the frame information translate into even smaller biases in the KSEs. It is important to note that Table 5 does not show actual survey estimates using final weights, but rather the result of plugging the observed and expected values from Table 4 into the logistic regression models formed for each of the KSEs using available frame information. In this analysis, the largest sample biases found using the base weights were in KSE 21, the percentage of children where someone smokes in the household (-17.41 percent), and KSE 14, the percentage of CSHCN whose families paid $1,000 or more out-of-pocket for medical and

health care in the past 12 months (14.47 percent). Using the nonresponse adjusted weights, this bias was somewhat improved for KSE 14, resulting in a smaller bias of 10.61 percent.[15] When the standard errors of the estimates are taken into account, the estimate using the final weights would lead to a difference large enough to be significant at the 95 percent confidence level.[16]

Looking at the model output in Table 5, the models resulted in less than one percent of children having someone who smokes inside their home. With such a small number, even small changes to the number can produce relatively large percent changes. So for KSE 21, the change of only 0.2 percentage points between the model evaluated at the observed means versus at the expected means leads to a large percent bias. Thus, looking solely at that percent bias can be misleading. The relatively high remaining upward bias for KSE 14 may be attributed to the difficulty in getting response from areas with lower household income as indicated in Table 2.

Table 5: Estimates of Nonresponse Biases in the Key Survey Estimates Attributable to Biases in the Frame Information

Key Survey Variable	Using Base Weight			Using NR* Adj. Weight		
	Model evaluated at observed respondent means[17]	Model evaluated at means expected under full response	Est. bias[18] (%)	Model evaluated at observed respondent means	Model evaluated at means expected under full response	Est. bias (%)
1. Percent of children with special health care needs (CSHCN)	20.0	20.3	-1.43	19.4	19.7	-1.40
2. Percent of children with emotional, developmental, or behavioral problem needing treatment/counseling	11.1	11.4	-2.67	10.9	11.1	-2.14
3. Percent of children with current asthma	7.0	7.3	-4.49	6.9	7.1	-3.54
4. Percent of children with current ASD†	2.4	2.5	-3.64	2.4	2.5	-2.88
5. Percent of children with current anxiety	8.1	7.9	3.37	7.9	7.8	2.12
6. Percent of children ever diagnosed with ADD‡ or ADHD§	8.5	8.7	-2.54	8.4	8.6	-2.55
7. Percent of children (6-17) who have been bullied in past 12 months	36.1	35.0	3.27	35.8	35.0	2.14
8. Percent of children (1-17) with excellent teeth condition	47.0	44.9	4.69	46.7	45.1	3.36

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[15] Note that the estimates of bias are not percentage points; they indicate the percent change in the observed estimate as compared to the expected estimate. A downward bias of five percent indicates that the current survey estimate is five percent lower than the "true" estimate. If the "true" estimate is 20 percent, then the survey estimate with a bias of -5 percent would be 19 percent, since (19 - 20)/20 = - 5 percent.

[16] The 2020 survey estimate for KSE 14 is 21.4 percent with a 95 percent confidence interval of (19.8, 22.9). Factoring in a 10.61 percent upward bias would lead to an estimate of 19.3 percent, since 21.4/1.1061= 19.3, which is less than the lower limit of the 95 percent confidence interval.

[17] Although the logistic regression models were evaluated at the observed means of the frame information, the results are not the observed means of the key survey variables, as would be the case for linear regression models.

[18] (Model evaluated at observed means – Model evaluated at expected means)/Model evaluated at expected means. Unrounded numbers are used in this calculation.

Key Survey Variable	Using Base Weight			Using NR* Adj. Weight		
	Model evaluated at observed respondent means[17]	Model evaluated at means expected under full response	Est. bias[18] (%)	Model evaluated at observed respondent means	Model evaluated at means expected under full response	Est. bias (%)
9. Percent of children in excellent or very good health	91.8	90.8	1.06	91.7	91.0	0.77
10. Percent of children (0-5) ever breastfed	85.0	83.2	2.19	84.8	83.3	1.75
11. Percent of children with a personal doctor/nurse	73.1	70.9	3.17	72.6	71.0	2.26
12. Percent of children who were ever covered by health insurance/plan during the past 12 months	95.5	95.0	0.59	95.5	95.1	0.41
13. Percent CSHCN who were ever covered by any health insurance/plan during the past 12 months	97.3	97.2	0.16	97.3	97.2	0.12
14. Percent CSHCN whose families paid ≥$1000 out-of-pocket for medical/health care in past 12 months	21.2	18.5	14.47	20.6	18.6	10.61
15. Percent CSHCN whose health caused family members to cut back/stop working in the past 12 months	15.3	16.3	-5.86	15.4	16.1	-4.13
16. Percent CSHCN (12-17) who had ≥1 preventative visit with health care professional in past 12 months	94.8	94.3	0.52	94.8	94.5	0.35
17. Percent of children (6-17) physically active ≥ 1 day during past week, for ≥1 hour	88.3	87.1	1.35	88.2	87.4	0.89
18. Percent of children (1-5) with >1 hour/day of screen time (tv, computer, cellphone, other electronic device)	59.6	61.9	-3.71	59.8	61.4	-2.65
19. Percent of children with family meals every day	49.4	50.1	-1.28	49.8	50.2	-0.77
20. Percent of children with neighborhood sidewalks/paths	81.0	81.3	-0.41	81.3	81.0	0.30
21. Percent of children where someone smokes in the household	0.8	1.0	-17.41	0.8	1.0	-15.50

Source: U.S. Census Bureau, 2020 National Survey of Children's Health internal data.

* NR – Nonresponse
† ASD – Autism Spectrum Disorder
‡ ADD – Attention Deficit Disorder
§ ADHD – Attention Deficit/Hyperactivity Disorder

Although the results of the modeling suggest that differences between sample respondents and nonrespondents in terms of the frame information largely lead to very little bias in the KSEs, this does not necessarily mean that the KSEs are biased very little. It is possible that there are differences between the sample respondents and nonrespondents that are not reflected in the frame information. For example, respondents may be healthier than nonrespondents but not any different based on the frame information available. The differences between the respondents and nonrespondents might be found with finer grain data, i.e., data on individual households. In this analysis, block group data is applied to every housing unit within a particular block group. It is possible that wide variation could exist among the housing units within the block group, but they all get the same block group value.

The results in this section also do not reflect the final raking of the nonresponse-adjusted weights to population control totals. This final raking could reduce or increase bias, but if so, that reduction or increase was not captured in the analysis in this section. Section VI of this document, "Comparison to Similar Estimates from Other Sources**,** presents analysis that makes use of the final, raked weights.

VI. Comparison to Similar Estimates from Other Sources

By comparing 2020 NSCH estimates to similar estimates from other surveys, evidence of bias analyzed thus far can be further investigated. If an estimate is close to the similar estimate from another survey, it provides further evidence that the weighting strategy was able to adequately account for nonresponse. Data from other surveys can also help detect potential biases beyond standard demographic variables. In addition to possible nonresponse biases, differences between estimates can often be attributed to differences in mode, timing of data collection, and/or wording of key items.

Table 6 provides a comparison of several 2020 NSCH KSEs, and a few additional health-related measures, to estimates from past years of the NSCH as well as the 2018 and 2019 National Health Interview Survey (NHIS).

When considering the estimates and their 95 percent confidence intervals, the following 2020 NSCH estimates are not significantly different from those of other surveys:
- Percent of children with special health care needs (KSE 1)
- Percent of children with current asthma (KSE 3)

Significant differences were found for the following estimates:

- **Percent of children ever diagnosed with ADD or ADHD (KSE 6) and Percent of children in fair or poor health** – These two 2020 NSCH estimates are not significantly different from the 2018 or 2019 NSCH nor the 2018 NHIS but are both significantly different from the 2019 NHIS. This could be due to a 2019 redesign in the NHIS. The National Center for Health Statistics, who produce the NHIS data, advise using caution when comparing the 2019 NHIS and earlier years at this time (National Center for Health Statistics, 2019). Additionally, given the low estimates of bias for both KSE 6 and KSE 9 in Table 5 as well as the closeness of these estimates to past NSCH survey years, the 2020 estimates being different from the 2019 NHIS does not seem to be a result of nonresponse.
- **Percent of children who have a usual place for sick care** – The 2020 NSCH estimate is not significantly different from the 2018 NSCH but is lower than the 2019 NSCH and the 2018 and 2019 NHIS. The NSCH estimate has remained lower than the NHIS since 2016. The difference in estimates could be due to differences in item wording between the two surveys, which can influence response patterns, leading to a difference in estimates.
- **Percent of children who missed 11 or more days of school in the past 12 months because of illness or injury** – The 2020 NSCH estimate is not significantly different from the 2018 NHIS but is lower than the 2018 and 2019 NSCH and the 2019 NHIS. This could

be due to effects of the COVID-19 pandemic since it resulted in many children participating in school virtually and thus less likely to miss school since they could participate from home, however there is no real way to investigate this currently.

- **Percent of children uninsured at the time of interview** – The 2020 NSCH estimate is not significantly different from the 2018 and 2019 NSCH but is higher than the 2018 and 2019 NHIS. The NSCH estimate has remained higher than the NHIS since the NSCH redesign in 2016.

Disparities in all of the estimates could also be due to mode effects. While the NSCH is solely a mail and web survey, the NHIS is conducted in-person. It is possible that having no interviewer present in the NSCH contributed to some of the differences observed here.

Table 6: Comparison of 2020 National Survey of Children's Health Estimates to Other Surveys

Estimates	Using Weight Prior Nonresponse (NR) Adj.	Using NR Adj. Weight	Using Final Weight	95 Percent Confidence Interval
Percent of children with special health care needs, KSE 1				
2020 National Survey of Children's Health (NSCH) Screener…	19.5	19.7	19.4	(18.9, 19.9)
2020 NSCH Topical………………………………………………..	20.1	19.6	19.7	(18.9, 20.5)
2019 National Survey of Children's Health (NSCH) Screener…..			18.7	(18.1, 19.2)
2019 NSCH Topical………………………………………………………			19.0	(18.2, 19.9)
2018 NSCH Screener……………………………………………………			18.6	(18.0, 19.2)
2018 NSCH Topical………………………………………………………			18.8	(18.0, 19.7)
Percent of children with current asthma, KSE 3				
2020 NSCH………………………………………………………..	7.2	7.1	7.2	(6.7, 7.7)
2019 NSCH…………………………………………………………			7.8	(7.1, 8.4)
2018 NSCH…………………………………………………………			7.7	(7.0, 8.3)
2019 National Health Interview Survey (NHIS)………………………			7.0	(6.4, 7.7)
2018 National Health Interview Survey (NHIS)………………………			7.5	(6.8, 8.2)
Percent of children ever diagnosed with Attention Deficit Disorder or Attention Deficit/Hyperactivity Disorder, KSE 6				
2020 NSCH, aged 3-17…………………………………………….....	10.3	10.1	10.2	(9.6, 10.8)
2019 NSCH, aged 3-17………………………………………………			9.6	(9.0, 10.3)
2018 NSCH, aged 3-17………………………………………………			9.9	(9.2, 10.6)
2019 NHIS, aged 3-17………………………………………………			8.8	(8.0, 9.5)
2018 NHIS, aged 3-17………………………………………………			9.8	(8.9, 10.7)
Percent of children in fair or poor health				
2020 NSCH………………………………………………………..	1.5	1.5	1.5	(1.2, 1.8)
2019 NSCH…………………………………………………………			1.5	(1.2, 1.9)
2018 NSCH…………………………………………………………			1.5	(1.2, 1.9)
2019 NHIS…………………………………………………………			2.7	(2.3, 3.2)
2018 NHIS…………………………………………………………			1.7	(1.5, 1.9)
Percent of children who have a usual place for sick care[19]				
2020 NSCH………………………………………………………..	77.5	77.1	76.0	(75.0, 77.0)
2019 NSCH…………………………………………………………			77.6	(76.5, 78.8)
2018 NSCH…………………………………………………………			77.0	(75.8, 78.1)
2019 NHIS…………………………………………………………			97.1	(96.6, 97.5)
2018 NHIS…………………………………………………………			95.7	(95.1, 96.3)

[19] Includes the Emergency Room.

Estimates	Using Weight Prior Nonresponse (NR) Adj.	Using NR Adj. Weight	Using Final Weight	95 Percent Confidence Interval
Percent of children who missed 11 or more days of school in the past 12 months because of illness or injury				
2020 NSCH, aged 5-17……………………………………………..	3.4	3.3	3.4	(3.0, 3.9)
2019 NSCH, aged 5-17………………………………………………			4.4	(3.8, 5.0)
2018 NSCH, aged 5-17………………………………………………			4.5	(3.9, 5.1)
2019 NHIS, aged 5-17………………………………………………			4.8	(4.2, 5.4)
2018 NHIS, aged 5-17………………………………………………			4.0	(3.4, 4.6)
Percent of children uninsured at the time of interview				
2020 NSCH……………………………………………..	6.5	6.6	7.1	(6.5, 7.7)
2019 NSCH…………………………………………………………			6.7	(6.0, 7.4)
2018 NSCH…………………………………………………………			6.2	(5.5, 6.9)
2019 NHIS…………………………………………………………			5.1	(4.5, 5.8)
2018 NHIS…………………………………………………………			5.2	(4.7, 5.7)

Sources: U.S. Census Bureau, 2018, 2019, and 2020 National Survey of Children's Health internal data
        National Center for Health Statistics, 2018 and 2019 National Health Interview Survey external data.

VII.   Conclusions

Assessing the extent to which nonresponse produces biased survey estimates is difficult. This analysis has applied the most commonly used methods, each of which has its shortcomings. By taking multiple approaches, it is hoped that reasonably accurate conclusions about the level of nonresponse bias in KSEs can be drawn.

Generally, the results indicate that the interviewed population was more likely to live outside of an MSA and in areas associated with higher levels of household income, home ownership, home values, and monthly rents (Table 2). Additionally, the interviewed population was more likely to live in areas associated with a greater percentage of college graduates and non-Hispanic White persons.

Table 5 presents estimates of bias for each KSE. The largest estimates of bias were associated with the percentage of children where someone smokes in the household and the percentage of CSHCN whose families paid $1,000 or more out-of-pocket for medical and health care in the past 12 months. For each of these estimates, the nonresponse adjusted weights reduced the bias somewhat, but some bias still remains (15.5 percent downward for smoking in household and 10.61 percent upward for out-of-pocket costs). All other KSEs had a remaining bias of approximately four percent or less, some upward and some downward, after nonresponse adjustments.

Table 6 compares 2020 NSCH estimates to similar estimates from other surveys. While some differences exist between the 2020 NSCH estimate and the similar estimate from another survey, these may reflect differences in the timing of data collection, item wording, survey redesign, and/or the mode of data collection. For example, the NSCH estimate of the percent of children ever diagnosed with ADD/ADHD was larger than the 2019 NHIS estimate, but very little evidence of bias was found for this estimate in the previous analysis (Table 5).

Taking all these analyses into account, there is no strong or consistent evidence of nonresponse bias in the 2020 NSCH. Although, response was higher where household income (as well as generally related factors such as education levels, rates of home ownership, and median monthly rent) was higher. And while the weighting did have a positive effect in reducing the difference between respondents and the full sample, it did not completely remove the differences, particularly related to income. Consequently, there is a possibility that some bias related to income remains in the 2020 NSCH estimates, but the analysis of the estimates in Tables 5 and 6 did not provide consistent support for an income bias. Therefore, the expectation is that if an income bias exists, it is small.

VIII.   References

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Table A1: Standard Errors for Response Rates Across Various Frame Subgroups (Table 2)

Frame Variable/Subgroup	Screener Respondents	Topical Respondents
--- National Survey of Children's Health Screener Response Data ---		
# of Eligible Children in Household		
1 …………………………………………		0.54
2 …………………………………………		0.56
3 …………………………………………		0.87
4+ …………………………………………		1.53
Presence of Children with Special Health Care Needs		
Yes ………………………………………		0.66
No ………………………………………		0.47
--- Frame Data: National Survey of Children's Health ---		
Presence of Child Flag		
Stratum 1 …………………………………	0.20	0.36
Stratum 2a ……………………………….	0.27	1.37
Metropolitan Statistical Area (MSA) Status		
In MSA …………………………………	0.21	0.42
Not in MSA ………………….…………	0.41	0.88
--- Frame Data: American Community Survey Block Group or Tract Data ---		
Median Household Income		
≤ median …………………………………	0.26	0.67
> median …………………………………	0.27	0.45
Median Home Value		
≤ median …………………………………	0.24	0.59
> median …………………………………	0.29	0.50
Median Gross Rent		
≤ median …………………………………	0.25	0.58
> median …………………………………	0.27	0.52
Tenure: Percent Owner		
≤ median …………………………………	0.26	0.67
> median …………………………………	0.26	0.42
Percent College Graduate		
≤ median …………………………………	0.26	0.66
> median …………………………………	0.27	0.43
Percent Hispanic		
≤ median …………………………………	0.25	0.42
> median …………………………………	0.27	0.58
Percent Black Alone		
≤ median …………………………………	0.29	0.56
> median …………………………………	0.25	0.53
Percent White Alone		
≤ median …………………………………	0.26	0.57
> median …………………………………	0.26	0.48
Percent Asian Alone		
≤ median …………………………………	0.26	0.62
> median …………………………………	0.27	0.48
Percent Other Race		
≤ median …………………………………	0.25	0.46
> median …………………………………	0.28	0.61

Source: U.S. Census Bureau, 2020 National Survey of Children's Health internal data.

Table A2: Standard Errors for Comparing Respondents and Nonrespondents Using Frame Information
(Table 3)

(column #):	All Sample Cases Using Base Weight (1)	Screener Respondents		All Topical Eligible Cases Using Weight Prior NR Adjustment (4)	Topical Respondents	
		Using Base Weight (2)	Using NR[*] Adjusted Weight (3)		Using Weight Prior NR Adjustment (5)	Using NR Adjusted Weight (6)
--- NSCH[†] Screener Interview Data ---						
# of Eligible Children in Household						
1				**0.30**	0.33	0.34
2				**0.43**	0.47	0.48
3				**0.41**	0.45	0.46
4+				**0.39**	0.42	0.44
Presence of CSHCN[‡]						
Yes				**0.42**	0.46	0.47
No				**0.42**	0.46	0.47
--- Frame Data: NSCH ---						
Presence of Child Flag						
Stratum 1	**0.16**	0.23	0.25	**0.44**	0.46	0.48
Stratum 2a	**0.16**	0.23	0.25	**0.44**	0.46	0.48
MSA[§] Status						
In MSA	**0.11**	0.17	0.14	**0.22**	0.24	0.24
Not in MSA	**0.11**	0.17	0.14	**0.22**	0.24	0.24
--- Frame Data: American Community Survey Block Group or Tract Data ---						
Median Household Income	**144**	227	223	**366**	401	408
Median Home Value	**988**	1,526	1,474	**2,504**	2,810	2,928
Median Gross Rent	**2**	3	3	**5**	5	5
Tenure: Percent Owner	**0.10**	0.14	0.14	**0.25**	0.27	0.29
Percent College Graduate	**0.08**	0.12	0.12	**0.21**	0.22	0.23
Percent Hispanic	**0.08**	0.11	0.12	**0.27**	0.29	0.31
Percent Black Alone	**0.07**	0.09	0.10	**0.18**	0.19	0.19
Percent White Alone	**0.09**	0.13	0.13	**0.23**	0.24	0.25
Percent Asian Alone	**0.04**	0.07	0.06	**0.10**	0.11	0.12
Percent Other Race	**0.04**	0.06	0.06	**0.12**	0.13	0.14

Source: U.S. Census Bureau, 2020 National Survey of Children's Health internal data.

[*] NR – Nonresponse

[†] NSCH – National Survey of Children's Health

[‡] CSHCN – Children with Special Health Care Needs

[§] MSA – Metropolitan Statistical Area